REASONS are given for adopting the formula of scandium oxide as Sc_2O_3, and the atomic weight of scandium is determined to be 44·0 (mean of four closely-agreeing results). Scandium is undoubtedly identical with Mendelejeff's ekabor.

THE specific heat of beryllium has been determined by Nilson and Pettersson. Between 0° and 100° the specific heat is 0·4246; between 0° and 300°, 0·5060. These chemists have likewise made a new determination of the combining weight of beryllium, and find it to be 4·55, which is a very little less than the number found by previous observers. They think that the atomic weight of beryllium is undoubtedly 13·65, and not 9·1, as generally supposed; oxide of beryllium is therefore Be_2O_3, and this metal is not to be placed, in Mendelejeff's system, as the first member of the magnesium group. Neither can beryllium form the first member of the aluminium group, as suggested by Lothar Meyer. Nilson and Pettersson detail many facts which lead them to regard beryllium as the first member of the group of cerite and gadolinite metals, which comprises the metals, Be, Sc, Y, La, Ce, Di, Tr, Y_α, Y_β, Soret's x, Er, Tu, Yb. The paper contains many most important chemical and physical data concerning the salts of the metals of this group.

FROM the specific heats of the oxides of beryllium, scandium, gallium, indium, and aluminium, the specific heat of oxygen in combination is deduced by Nilson and Pettersson as being 2·3 to 3·1; the mean specific heat of oxygen in combination is 4·0; the oxides named are therefore somewhat anomalous.

THE "molecular volume," *i.e.*, $\frac{\text{molecular weight of gas,}}{\text{sp. gr. of solid}}$ of the various molecules of water of hydration has been recently shown by Thorpe and Watts to vary in the magnesium group of sulphates; Nilson and Pettersson obtain nearly the same number (8·5) as representing the mean volume of each water-molecule in the sulphates of yttrium, erbium, and ytterbium; but a somewhat larger number (11·5) for the mean volume in the sulphates of cerium, lanthanum, and didymium.

PHYSICAL NOTES

IN liquids small particles often show dancing motions under the microscope, and similar motions have been attributed to dust-particles in air, and accounted for by the shock of molecules with the particles. In a recent paper treating fully of the movements of very minute bodies (*Münch. Ber.*, 1879, p. 389) Herr Nägeli calculates from data of the mechanical theory of gases as to the weight and number and collisions of molecules, the velocity of the smallest fungus-particles in the air that can be perceived with the best microscopes, supposing a nitrogen or oxygen molecule to drive against them. It is, at the most, as much as the velocity of the hour-hand of a watch, since these fungi are 300 million times heavier than a nitrogen or oxygen molecule. The ordinary motes would move 50 million times slower than the hour-hand of a watch. Numbers of the same magnitude are obtained for movements of small particles in liquids. In both cases a summation of the shocks of different molecules is not admissible, as the movements are equably distributed in all directions. Herr Nägeli therefore disputes the dancing motion of solar dust-particles, and attributes the Brownian molecular motion to forces active between the surface-molecules of the liquid and the small particles; but he does not say how he conceives of this action.

THE absorption of heat-rays by powders has been lately investigated by Herr van Deventer (*Inaug. Diss. Leid.*, 1879, p. 78, or *Wied. Beibl.*, 6) without use of any binding material. Under a copper cube kept at 100° was brought a thermo-element consisting of a brass plate, on the lower side of which was soldered a piece of bismuth and antimony (parallelopiped shape). On the plate was strewn the powder to be examined. A second similar element, with thermo-element lampblacked, served for control. Briefly, the results were these: (1) Powdered substances in the same physical state have different absorptive power; (2) this depends on the thickness of the absorbing layer: each powder has its maximum absorption layer; (3) quite comparable values for the absorption cannot be had, as the thickness of the powder layer cannot be exactly determined; (4) the divergences proved in Tyndall's results with different binding materials are attributed to his not having taken into account the maximum emission layer; (5) whether the binding material affects absorption, and if so, how, can be demonstrated by the author's method (the element being painted over with the liquid holding the powder in suspension): but experiments are here wanting; (6) the author's series of powders arranged according to absorption is quite different from Tyndall's emission series.

DR. PULUJ observes that if an electric radiometer is worked for some minutes and then the circuit is broken, a reversed motion is immediately set up, which continues for four or five minutes with an enormous rapidity. This he explains by assuming that there are really two actions tending to produce rotation: the electric reaction between the vanes and the molecules, and the heating of the metallic side of the vanes; that these two actions oppose one another, but that at small pressures, such as the high vacua, the electrical forces are in excess. When however they are brought to an end the heat-forces assert themselves, producing the opposite rotation.

FROM recent experiments (described in *Wied. Ann.*, No. 7) Herr Heitz concludes that the kinetic energy of the electric current in 1 cubic millimetre of a copper conductor, traversed by a current of unit electromagnetic density, is less than 0·008 milligramme-millimetre. As the kinetic energy is equal to half the mass multiplied by the square of the velocity, the mass of the positive electricity in 1 cub-mm. is $<\frac{0\cdot008\text{ mg.}}{v^2}$. *E.g.*, if $v = 1$ mm., 10 mm., &c., the mass of the positive electricity $<0\cdot008$ mg., $<0\cdot00008$ mg., &c. The limits here assigned, however, are exceeded where the densities of the electricity in the materials used are as their conductivities. (The experiments were made both with straight wires and with spirals, the former giving the more reliable results.)

THE results of theory regarding stationary vibrations of water are, in a recent paper (*Wied. Ann.*, No. 7) by Herr Kirchhoff and Herr Hansemann, compared with those of experiments in which a prismatic glass vessel, whose vertical cross-section consisted of two straight lines meeting at a right angle and equally inclined to the vertical, formed part of a pendulum, and was vibrated by electromagnetic means about that angle as axis. In the *Journal de Physique* (June) M. Lechat studies the surface vibrations of a liquid in a rectangular vessel, a small vertical rod having been adjusted to any point of the surface, and vibrated in the direction of its length by an electro-magnetic arrangement. The resultant forms were thrown on to a screen by means of a reflected beam of light.

IN a recent paper to the Belgian Academy (*Bull.*, No. 5) Abbé Spée contends that the spectral line D_3, with wave-length about 588, observed in the chromosphere and protuberances, and assigned to a hypothetical body, helium, which some suppose to have a still more simple molecular constitution than hydrogen, probably belongs in reality to this gas. As to its non-reversibility, he considers that at a very small distance from the chromosphere the solar hydrogen may be so far cooled as to be comparable to that which we manipulate, and so, unable to extinguish waves which it can no longer produce, just as a stretched cord loses the property of vibrating in sympathy if its tension have been altered.

PURSUING his researches on the welding of solid bodies by pressure, M. Spring has subjected to various strong pressures (up to 10,000 atm.) more than eighty solid pulverised bodies; this was done in vacuo, and in some cases at various temperatures. The results are highly interesting. All the crystalline bodies proved capable of welding, and in the case of bodies accidentally amorphous the compressed block showed crystalline fracture; crystallisation had been brought about by pressure. Softness favours the approximation of the particles and their orientation in the direction of the crystalline axes. The amorphous bodies, properly so called, fall into two groups, one of substances like wax (*ciroid* bodies), which weld easily, the other of substances like amorphous carbon (*aciroid* bodies), which do not weld. The general result is that the crystalline state favours the union of solid bodies, but the amorphous state does not always hinder it. M. Spring says the facts described do not essentially differ from those observed when two drops of a liquid meet and unite. Hardness is a relative, and one may even say subjective, term. Water may appear with a certain hardness to some insects, and if our bodies had a certain weight we should find the pavement too soft to bear us. Again, prismatic sulphur is changed by compression to octahedric sulphur; amorphous phosphorus seems to be changed to metallic; other amorphous bodies change their state, and mixtures of bodies react chemically if the specific volume of the product of the reaction is smaller than the sum of specific volumes of the reacting bodies. In all

© 1880 Nature Publishing Group

cases the body is changed into a denser variety, whence may be inferred that the state taken by matter is in relation to the volume it is obliged to occupy under action of external forces. This (M. Spring points out) is merely the generalisation of a well-known fact. Some curious results are deduced from it. The researches described have important bearings on mineralogy and geology.

Mr. R. Crowe of Liverpool communicates to the *British Journal of Photography* an account of some attempts to photograph a landscape by the aid of lightning-flashes. A gelatine plate, requiring by day an exposure of two seconds, was exposed from 10.15 p.m. to 10.45 p.m., during which time there were 120 brilliant flashes and about half as many minor ones. Most of these were in a horizontal direction, and five or six of then were imprinted on the negative. A perpendicular flash which struck a church-tower half a mile away was rendered with extraordinary sharpness and brilliancy. The surrounding objects, in spite of the long exposure, were but feebly impressed; whence Mr. Crowe argues that though the light of a flash of lightning is of a very actinic character, there still is not sufficient volume of light to illuminate a landscape or building to allow a successful photograph to be taken. Mr. Crowe further suggests that an attempt should be made to photograph, for scientific purposes of reference, the varied forms assumed by lightning at different times and in different countries.

GEOGRAPHICAL NOTES

News has been received from Zanzibar that Capt. Carter and Mr. Cadenhead, of the Belgian Exploration Expedition, have been killed by the chief "Wrambo." This is probably the chief Mirambo, who formerly caused so much trouble to explorers between Zanzibar and Lake Tanganyika, but of whom Mr. Stanley gives so good a report in his last work. It was Capt. Carter who was so successful in the introduction of Indian elephants into Africa.

The August number of the Geographical Society's *Proceedings* contains Mr. im Thurm's paper on his journey in British Guiana, already noticed in our columns, but the principal feature this month is of course the paper on Kuldja by Major F. C. H. Clarke, R.A., a well-known military writer on Eastern affairs. After a useful historical sketch, Major Clarke deals successively with the geography, orography, rivers, communications, towns, population, climate, vegetable products, and minerals of the region, and furnishes much interesting information, collected with evident care. This paper is followed by an account of M. Severtsoff's journey in Ferghana and the Pamir, from a translation by M. Alexis Lomonossoff, of the Russian Geographical Society. The geographical notes furnish information respecting the East African Expedition, the climate of Matabele-land, the recent observations of Dr. Matteucci in Kordofan, and Dr. Gerhard Rohlfs' account of the Jofra oasis. After notes on American Arctic expeditions and the position of the Crozet Islands, we have Mr. Whymper's account of his ascent of the famous Antisana mountain in South America, and lastly Mr. A. Forrest's own narrative of his journey through North-Western Australia. Two maps are given with the present number, one of British Guiana, which is very acceptable, and the other of the Kuldja district and the Russo-Chinese frontier in Turkistan.

With the August number of their *Herald* the Baptist Missionary Society publish a map of Equatorial Africa, which, though presumably not laying claim to scientific accuracy, is of interest as showing what an immense region can be reached by means of the River Congo and its affluents. The map is intended to illustrate the scheme which Mr. Arthington has sketched out for the application of his last munificent donation to the Society. The geographical part of this great task consists in the exploration of the Nkutu and Ikelemba Rivers, the two principal tributaries of the Congo from the south, after passing Stanley Pool, and the opening of a route towards Lake Albert, along the Mbura River, which enters the Congo above Stanley's Arawimi.

M. C. E. de Ujfalvy left Paris in July to undertake a new and important journey in Central Asia. He goes in the first instance to Orenburg, and thence to Tashkend, where he hopes to arrive at the end of next month. He contemplates staying the winter at Samarkand, and will commence his explorations next spring. His programme is an extensive one, and embraces a considerable part of the Southern Pamir region. In the course of his labours he will visit the Upper Zarafshan valley, Karategin, Wakhan, Shignan, Badakshan, and probably Afghanistan. The return journey will, if possible, be made through Persia and the Caucasus.

News has arrived in Paris that a French mission has reached Segon Sokkova and has been well received by King Ahmadan. M. Soleillet, who is on his way to Senegal, is not a member of this expedition, and will proceed by another route to the same city.

The *Weimar Gazette* states that Dr. Gerhard Rholfs is about to set out for Abyssinia, accompanied by Dr. Stecker, who will attempt a new exploration in Central Africa.

It is stated that a fifth Belgian Expedition is about to start for Africa, intended to reinforce the expedition on the Congo under Mr. Stanley. It will be commanded by Lieut. Braconnier.

The August number of *Petermann's Mittheilungen* contains an exhaustive article by Dr. Behm on the Island of Rodriguez, accompanied by a very clear map. Bernhard v. Struve discusses the question of an inland trade-route through Siberia. An excellent hydrographical article, with a large-scale chart, on the Lower Weser from Bremen to Bremerhaven, is contributed by Oherbau-Director L. Franzius of Bremen. The results of the various East African International Expeditions are described. The researches of the Danish schooner *Ingolf* in the seas around Iceland in 1879 are described by H. Wiehmann.

The London Missionary Society have received intelligence of the safe arrival of their new Tanganyika Expedition at Zanzibar on May 29. The party is composed of the Revs. A. J. Wookey and D. Williams, with Dr. Palmer as medical assistant. When the last mail left, an efficient leader and some of the head-men had already been engaged, and they hoped to start for the interior early in July.

The Church Missionary Society are sending out further reinforcements for their Nyanza mission. The Rev. P. O'Flaherty, an able Oriental scholar, who was an interpreter on Lord Raglan's staff in the Crimean war, left for Zanzibar early in July, and will probably accompany the Waganda chiefs on their journey back to Lake Victoria. Mr. W. E. Taylor, of Hertford College, Oxford, who has been trained as a medical missionary, and Mr. A. J. Biddlecombe have, we believe, just started for East Africa, and will in the first instance join Mr. Copplestone at Uyui.

L'Exploration for August 5 contains some interesting extracts from the letters of Col. Prejevalsky, describing the difficulties he had to encounter in attempting to reach Lhassa, in which he was foiled. The intrepid Colonel has evidently succeeded in making considerable natural history collections.

THE STRUCTURE AND ORIGIN OF CORAL REEFS AND ISLANDS[1]

DARWIN'S THEORY.—During the voyage of the *Beagle* and subsequently, Mr. Darwin made a profound study of coral reefs, and has given a theory of their mode of formation which has since been universally accepted by scientific men.

Darwin's theory may be said to rest on two facts—the one physiological, and the other physical—the former, that those species of corals whose skeletons chiefly make up reefs cannot live in depths greater than from 20 to 30 fathoms; the latter, that the surface of the earth is continually undergoing slow elevation or subsidence.

The corals commence by growing up from the shallow waters surrounding an island, and form a fringing reef which is closely attached to the shore. The island slowly sinks, but the corals continually grow upwards, and keep the upper surface of the reef at a level with the waves of the ocean. When this has gone on for some time a wide navigable water channel is formed between the reef and the shores of the island, and we have a barrier reef. These processes have but to be continued some stages further, when the island will disappear beneath the ocean, and be replaced by an atoll with its lagoon where the island once stood.

According to this simple and beautiful theory, the fringing

---

[1] Abstract of paper read at the Royal Society of Edinburgh by Mr. John Murray. (Published by permission of the Lords Commissioners of the Treasury.)

© 1880 Nature Publishing Group